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What Influences Consumer Inflation Expectations?

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Abstract

Using data from the Michigan survey, this paper empirically analyses the differing influences on inflation expectations over sub-groups of US consumers, defined by gender, age and income. We find little support for the hypothesis that the differences are associated with inflation experience, as represented by the expenditure patterns of these groups, and strong evidence of differing responses to economic news. While negative inflation news leads to significantly higher expectations across all groups, heterogenous responses are evident to other types of news (particularly that related to employment), with positive news often unimportant. A common finding across all sub-groups is that the housing inflation differential compared with overall CPI plays a negative role for expectations, which may be associated with the measurement of this component in the CPI.

JEL codes: C53, D84, E31, E37

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1. Introduction

The importance of inflation expectations has often been emphasised by central bankers, such as Poole (2004), with such expectations also playing a key role in modern macroeconomic theory based on the New Keynesian paradigm. Although the literature predominantly assumes expectations to be homogenous, Carroll (2003), Mankiw, Reis and Wolfers (2003), and Souleles (2004), among others, draw attention to the importance of heterogeneity.

One strand of literature establishes that inflation expectations differ over demographic sub-groups (depending on gender, age, etc); studies include Bryan and Venkatu (2001), Janssen (2004), Jonung (1981), Lombardelli and Saleheen (2003) and Souleles (2004). Although this suggests that consumers form inflation expectations in the light of their backgrounds and experiences, evidence on the nature of such a link remains somewhat elusive (Bryan and Venkatu 2001, Lombardelli and Saleheen, 2003). From a different perspective, and ignoring demographics, Carroll (2003) shows that aggregate expectations are influenced by the intensity (frequency) of media news reports concerning inflation, while Lamla and Lein (2008) find that the positive or negative tone of these is important. Indeed, Maag and Lamla (2012) conclude that the tone of news is a key determinant of inflation expectation dispersion (referred to as disagreement), with news of rising inflation reducing dispersion.

The present paper seeks to further understanding of what influences the inflation expectations of US consumers. Our starting point is that demographics are at least potentially important, and we investigate three panels of inflation expectations data aggregated from the University of Michigan Survey according to the criteria of gender, age and income. Each panel datasets is confronted with explanatory variables relating to lagged 'all agent' CPI inflation, together with current inflation differentials for commodity groups and also news variables. The inflation series are common across all sub-groups. Since expenditure surveys show demographics to be related to expenditure patterns, the inclusion of inflation differentials (relative to overall CPI) allows us to examine whether sub-groups use relative inflation within their own consumption baskets in forming their expectations, as suggested by Bryan and Venkatu (2001), Jonung (1981), and others.

News variables are specific to each sub-group and, following Lamla and Lein (2008) and Maag and Lamla (2012), we distinguish between positive and negative news. However, in

contrast to these and other studies (including Carroll, 2003), we do not restrict relevant news to only that concerned explicitly with inflation, since a well-informed economic agent will recognise that information concerned with (for example) employment has implications for future inflation. Further, whereas these previous studies measure news as the numbers of items in the media relating to inflation, we employ Michigan Survey data (aggregated to the sub-group level) on news heard by the respondent. We believe that the latter more adequately represents the 'volume' of news, as heard by the different sub-groups of consumers, than the former.

The econometric testing methodology we employ controls for unobserved effects common to all sub-groups within a panel through allowing contemporaneous disturbance correlations, with possible unmodelled temporal autocorrelation also taken into account. An alternative to our use of demographic-based panels of aggregated data would be to use the underlying individual-level Michigan Survey data and include demographic variables, together with their interactions with news variables, among the explanatory variables. However, this would not only lead to the use of a very large number of explanatory variables, but the inclusion of time dummies to account for common effects would preclude investigation of the role of commodity category inflation differentials, or lagged inflation itself, since these are constant over all individuals for a given time period.

To summarise, our results provide little support for the hypothesis that inflation experiences associated with different consumption baskets across demographic sub-groups influences their inflation expectations. The housing inflation differential is always significant, with coefficient varying over gender and age, while the transport inflation differential is sometimes significant, but these significant coefficients are generally negative rather than the positive sign anticipated. News, particularly negative news, plays a strong role in expectation formation, supporting the idea that agents are attuned to some types of news and respond to these in a forming their views of future inflation. The sub-group at the upper end of the income distribution appears to pay most attention to this news.

Reviewing the remainder of this paper, Section 2 discusses various important issues related to data, including the demographic panels we construct and our news variables, while Section 3 outlines our econometric methodology. Section 4 presents our substantive empirical results,

showing the influences of inflation differentials, lagged inflation and news on expectations over demographic sub-groups. Finally section 5 concludes.

2. Inflation, Inflation Expectations and Economic News

This section introduces the data used in our analysis and then outlines how this is employed in the econometric analysis, Subsection 2.1 briefly reviews US inflation, before discussing (in subsection 2.2) the SRC measure of inflation expectations and the variables (subsection 2.3).

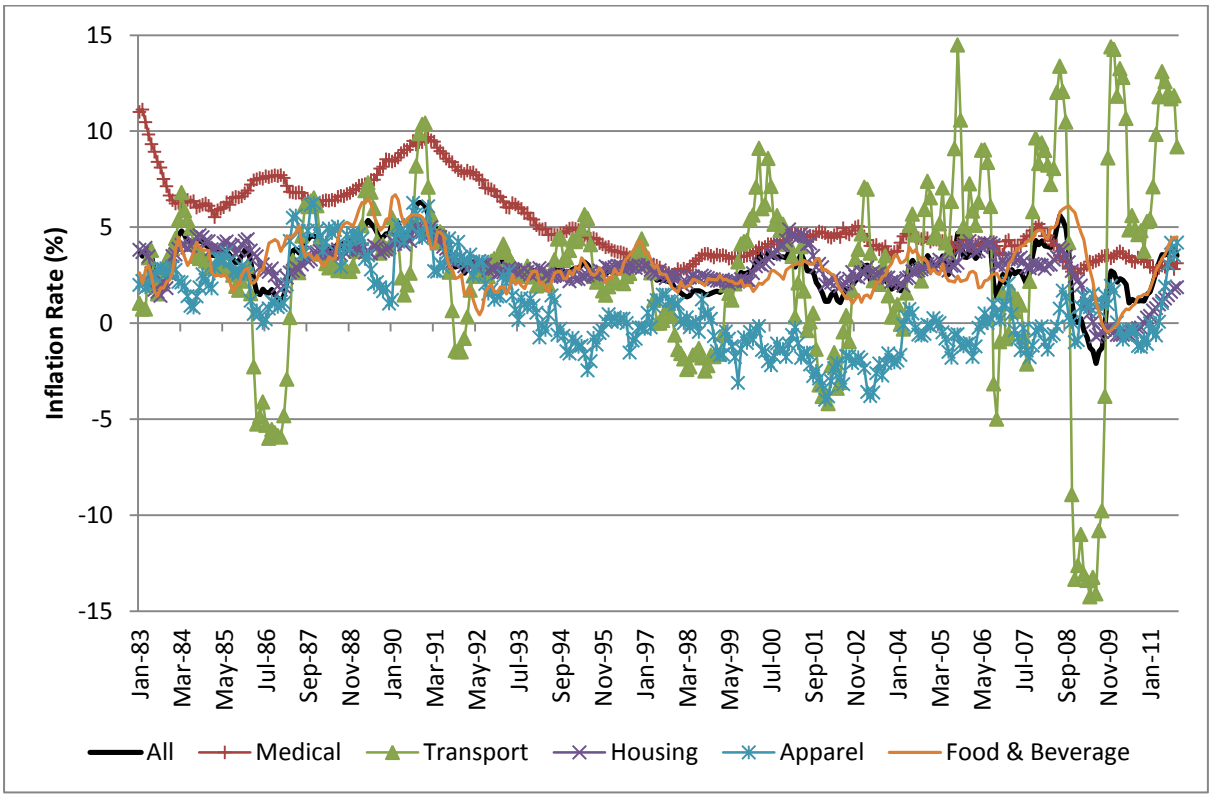
2.1 US Inflation

Changes in the cost-of-living for US consumers are commonly measured as the percentage change in the Bureau of Labor Statistics consumer price index for all-urban consumers (CPI-U) series. This index is constructed from the prices of individual commodities using region-specific expenditure information from the Consumer Expenditure Survey (CES). In addition to the aggregate CPI-U, price indices are available at lower levels of aggregation, for which the major category levels are: Food and Beverages, Housing, Apparel, Transportation, Medical care, Recreation, Education and communication, Other goods and services (Bureau of Labor Statistics, 2009).

It is often suggested (for example, Jonung, 1981, Lombardelli and Saleheen, 2003) that differences in inflation expectations over demographic sub-groups may be associated with their purchasing patterns. Although CES data are not available by gender (as it is a household survey), Appendix 1 provides information about expenditure patterns for various US demographic sub-groups. This makes clear that marked differences exist for health care (where those over 65 spend most, in relation to income) and housing (where the poorest spend most). Not surprisingly, older consumers spend proportionately less on apparel than the young. However, in all cases the housing category accounts for the largest proportion of overall expenditure. Excluding insurance and pension contributions, this is followed by transportation, food, health care, entertainment and apparel, with the order sometimes differing over sub-groups.

Figure 1 shows annual CPI-U (all commodity) inflation and also annual inflation in each of the five major-level commodity groups we employ in our later analysis, over January 1983 to October 2011. These commodity groups are selected as the most important according to the CES and for which data are available over the period[1]. This figure shows there are sometimes large and quite persistent differences between inflation rates across commodity categories and in relation to CPI-U. For example, medical care price inflation tends to be higher than average inflation while apparel price inflation tends to be lower. Transportation inflation is the most volatile, presumably due to oil-price variability. Since it accounts for a large proportion of overall expenditure, housing inflation (which includes utilities) generally differs little from average inflation, as does food and beverage inflation.

Figure 1: Annual CPI Commodity Category and Overall Inflation



Notes: Inflation is calculated as the percentage change in the respective price index over the preceding 12-months. The 'all' category represents CPI-U calculated inflation, with inflation shown also for the commodity categories indicated. Data is sourced from the Bureau of Labor Statistics Consumer Price Index (CU) flat file obtained from ftp://ftp.bls.gov/pub/time.series/cu/

[1] Based on the CES expenditure patterns, shown in Appendix Table A.1, we would have liked to include the inflation differential for Recreation in our analysis, but this is available only from 1993.

The sample period of January 1983 to October 2011[2] gives 345 monthly observations on each variable for our analysis below. Although earlier data are available, our sample starts at 1983 due to the evidence that US inflation is non-stationary prior to this date (Halunga, Osborn and Sensier 2009, Zhang and Clovis 2009).

Based on their differing expenditure patterns alongside the commodity inflation rates in Figure 1, it is clear that demographic sub-groups can experience different rates of inflation in their personal expenditures. An important caveat, however, is that CPI housing inflation uses a rental equivalent in computing the housing costs of owner occupiers (Bureau of Labor Statistics, 2011, p.18). Therefore, this component does not directly relate to their actual housing expenditure.

2.2 Inflation Expectations

Since 1978, monthly US year-ahead inflation expectations have been recorded by the University of Michigan's Survey Research Centre (SRC) as part of the Survey of Consumer Attitudes and Behavior[3]; see Curtin (1996) for details. Respondents are asked to quantify their expectation of the rate of change of "prices in general" in the 12-month period following interview. The survey is designed as a short rotating panel, where around 40% of approximately 500 monthly interviews are recontacts from 6-months previously. Anderson, Osborn and Becker (2010) find that recontacts have been incentivised to notice inflation, and therefore have improved forecasts compared to initial contacts. Aggregating across all interviews would therefore yield a misleading indication of how agents forecast, and so the subsequent analysis uses only expectations from first interview respondents.

For the purposes of analysis, we aggregate data to form gender, age (18 to 34, 35 to 54 and 55 or over) and income panels, where gender and age refer to the respondent and income to the

[2] At the time of writing, this is the most recent date for which inflation expectations data is available in disaggregated form.

[3] Although similar surveys are now conducted in many other countries, this US survey is the longest running of these. Prior to January 1986, the Michigan survey also asked respondents for their outlook on prices over different time-horizons, with these questions adding the qualification of "things you buy". Although these additional questions may help to clarify the nature of expectations, this distinction between "prices in general" and "things you buy" is somewhat vague, and (more importantly) later surveys do not include the latter.

household. We also investigated a panel based on education, with a similar pattern of results to those reported for the income panel. The coding of income sub-groups into the bottom, middle and top thirds of the income distribution is done by SRC, based on information provided by the respondent and with relatively few missing values. Table 1 presents descriptive statistics relating to the demographic sub-groups we employ, and shows that these are representative in the sense they are computed from a reasonable number of individual responses. Although the sub-groups across a panel each comprise approximately equal numbers of observations on average, there is a downward trend in the proportion of younger first interview respondents over the period, with an increasing trend in those aged 55 or over, such that the latter group comprises more than half the total sample for the most recent observations.

Table 1: Descriptive Statistics

		Respondents	Expectations	None-Heard	+ve Government & Defence	+ve Employment & PP	+ve Money & Prices	+ve Inflation	+ve Miscelaneous	-ve Government & Defence	-ve Employment & PP	-ve Money & Prices	-ve Inflation	-ve Miscelaneous
All Forecasters		277	3.964	0.414	0.016	0.067	0.051	0.007	0.062	0.038	0.183	0.064	0.026	0.072
Gender	Male	128	3.403	0.393	0.018	0.071	0.067	0.010	0.067	0.045	0.155	0.077	0.028	0.069
	Female	149	4.447	0.433	0.013	0.063	0.037	0.005	0.057	0.032	0.207	0.053	0.024	0.075
Age	18-34	83	4.150	0.485	0.014	0.066	0.046	0.007	0.058	0.032	0.149	0.055	0.023	0.064
	35-54	109	3.883	0.354	0.017	0.074	0.063	0.008	0.067	0.042	0.194	0.077	0.028	0.077
	55+	86	3.764	0.438	0.014	0.058	0.037	0.006	0.058	0.036	0.201	0.053	0.026	0.074
Income	<33	66	4.849	0.527	0.013	0.053	0.024	0.006	0.051	0.033	0.167	0.035	0.025	0.066
	34-65	87	4.026	0.421	0.015	0.067	0.044	0.006	0.065	0.036	0.185	0.060	0.025	0.077
	66>	103	3.318	0.322	0.018	0.081	0.077	0.010	0.068	0.043	0.190	0.089	0.029	0.072

Note: values are the average within each sub-panel.

In common with previous studies for various countries (Jonung, 1981, Bryan and Venkatu, 2001, Lombardelli and Saleheen, 2003, Souleles, 2004), Table 1 shows that, on average, females have higher inflation expectations than men. Further, the young and (particularly) those in the bottom third of the income distribution have higher expectations than agents overall. Other statistics in the table relate to news variables, discussed in the next subsection.

2.3 Economic News

As noted in the Introduction, there is growing evidence on the importance of 'news' for the formation of inflation expectations by consumers. Lamla and Lein (2009) and Maag and Lamla (2012) also find positive and negative news to play distinct roles. However, their analyses relates to Germany over relatively short sample period (1998 to 2006 or 2007), and the SRC data for the US enables us to undertake a more thorough examination.

As part of the monthly SRC survey, respondents are asked about any favourable or unfavourable changes in economic and business conditions heard over the previous few months. The response of each individual is coded to one of approximately 80 categories pre-defined by SRC, including no news and otherwise separated as favorable or unfavorable. The individual categories are detailed in Appendix 2 and summarized by type in Table 2[4]. Although SRC categories news into types in a similar way to Table 2, our analysis separates their Prices type into two: namely, Money and Profits, and Inflation.

Table 2: News Categories

News Type	Brief Description
None Heard	No news, unsure about whether good or bad.
Government and Defence (G&D)	Elections, defence spending, global defence situation, government spending, taxation reforms and rebates, fiscal policy, business stimulus packages.
Employment and Purchasing Power (EPP)	Opening/closing stores and factories, consumer demand, wages and personal income, unemployment rate, population size, debts, assets, GNP.
Money and Profits (M&P)	Interest rates, credit availability, stock prices, profits, balance of payments, exchange rates, price and wage controls.
Inflation (I)	Inflation, deflation, disinflation.
Miscellaneous (M)	Race relations, crime rate, union power, farming, energy, economics stability.

Notes: See Appendix 2 for detailed descriptions. Within each news type, separate categories capture favorable and unfavorable news.

[4] We also experimented with using the raw data to form other type categorisations, but the small proportions in individual categories made it difficult to draw conclusions based on these.

The news variables are aggregated analogously to the expectations data. Hence, the value of the news variable of a specific type (such as favorable inflation news) in our empirical model is the proportion of survey respondents in the corresponding demographic sub-group who report hearing news of that type.

The descriptive statistics relating to news in Table 1 show differences over demographic sub-groups. Perhaps most notable is that higher income groups hear more economic news (and hence a smaller proportion hear no news) than those on higher incomes. Indeed, casual observation indicates that higher inflation expectations are reported by sub-groups who also report hearing no economic news. It is also noteworthy that, in general, substantially more news heard relates to unfavorable changes in employment and purchasing power than in other categories, with such news heard particularly by females, older respondents and those not at the bottom of the income distribution. Only around 3.3 percent, overall, report having heard inflation news on any type. Hence, restricting attention to news explicitly related to inflation would omit a great deal of information that agents potentially use when forming their inflation expectations.

3. Methodology

This section firstly discusses our general model, followed by our econometric approach.

3.1 The Model

Jonung (1981) and others hypothesise that inflation expectations are formed in the light of inflation in the consumption basket relevant to the individual. However, this does not adequately explain either observed inflation expectations or differences in perceived past inflation (Bryan and Venkatu, 2003). To account for these empirical features, in the absence of news, our model for the mean inflation expectation of demographic sub-group *i* at month *t* for inflation over the next year has the form:

$$E_t^i \pi_{t+12} = \alpha_i + \beta_{i0}\pi_{t-1} + \sum_{j=1}^{k} \beta_{ij}\left(\pi_t^j - \pi_t^{CPI-U}\right) + \sum_{j=1}^{m} \gamma_{ij} News_{it}^j + u_{it} \qquad (1)$$

where π_t is annual inflation to *t* and the superscript refers to either overall CPI-U inflation or inflation in a specific commodity category. The disturbance u_{it} may be heteroskedastic, but more importantly will be correlated across demographic sub-groups. Our econometric methodology takes account of this feature, as discussed in the next subsection.

Equation (1) implies that mean for sub-group *i* inflation is influenced by actual inflation, which is lagged by one month due to the publication delay for this variable[5]. The sub-group specific coefficient allows for different responses to this value, reflecting evidence that sub-groups may have different perceptions of actual inflation (Jonung, 1981, Bryan and Venkatu, 2003). Expectations based on lagged inflation are updated in *t* through purchases, so that consumers have information about inflation differentials for commodities they buy, represented by *k* commodity groups in (1). The assumption that consumers are aware of the contemporaneous inflation differential in relation to CPI-U (but not necessarily the individual inflation rates themselves) is clearly a simplification, but is consistent with the idea that consumers make informal inflation comparisons across types of commodities. Clearly, only a subset of all possible categories can be used in the regression, to avoid exact multicollinearity.

Our empirical model employs inflation differentials the five important commodity categories shown in Figure 1, namely: medical care, food & beverages, transport, apparel and housing inflation. The hypothesis that inflation expectations are influenced by inflation in the consumption basket is examined through these differentials. If, say, consumers from poor households interpret a positive inflation differential for food (where they have relatively large expenditure) as indicating higher (future) prices in general, then we anticipate a positive coefficient on this differential for the lower income sub-group. On the other hand, a negative coefficient for the differential relating to commodity group *k* has the implication that $(\pi_t^{CPI-U} - \pi_t^k)$ positively influences inflation, which may indicate that consumers effectively adjust their perception of current inflation by removing that related to commodity group *k*.

[5] Depending on when the consumer is interviewed, the latest published inflation news may relate to actual inflation one or two months earlier, due to the previous month's inflation being published mid-month. Changing the one month lag to two months for CPI-U does not substantially change the results obtained.

Equation (1) also allows updating of expectations in the light of news, which is found to play an important role by Carroll (2003), Mankiw, Reis and Wolfers (2003), and others. Further, Maag and Lamla (2012) hypothesise, and find empirical evidence that, a high volume of media coverage relating to rising inflation leads to more homogenous inflation expectations because agents perceive negative news to be more important than positive news. The SRC data, however, records the nature of (the single) category of news heard, which proxies the most important recent economic news as perceived by the respondent. Therefore, we are better able to separate perceptions of importance from the impact of types of (important) news on inflation expectations. In particular, Table 2 indicates that more consumers recall hearing negative than positive economic news, but this does not necessarily imply that negative news heard plays a different role compared with positive news.

We investigate asymmetry in news influences by separately including positive and negative news, using the type classifications of Table 2. Since each respondent reports hearing either no news or one type of news, the proportions (for a given demographic sub-group for a specific survey month) sum to one when aggregated over sub-groups. To avoid exact multicollinearity, the no news category serves as the base category and is omitted from the model. Therefore, we employ $m = 10$ news categories, comprising positive and negative news for each of the five news types.

3.2 Econometric Methodology

Our panels for gender, age or income contain $n = 2$ or 3 demographic sub-groups, with (1) estimated for each of these $i = 1, ..., n$ sub-groups. All $T = 345$ monthly observations for the relevant panel are stacked into a system:

$$Y = X\boldsymbol{\beta} + u$$

$$\underset{nT\times 1}{Y} = \begin{bmatrix} y^1 \\ y^2 \\ \vdots \\ y^n \end{bmatrix} \quad \underset{nT\times 17n}{X} = \begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & & \vdots \\ \vdots & & & 0 \\ 0 & \cdots & 0 & X_n \end{bmatrix} \quad \underset{8n\times 1}{\boldsymbol{\beta}} = \begin{bmatrix} \boldsymbol{\beta_1} \\ \boldsymbol{\beta_2} \\ \vdots \\ \boldsymbol{\beta_n} \end{bmatrix} \quad \underset{nT\times 1}{u} = \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{bmatrix} \tag{2}$$

where X_i contains observations on the 17 regressors of (1), including the intercept, and

$$\boldsymbol{\beta_i} = \left(\alpha_i, \beta_{i0}, \beta_{i1}, \ldots, \beta_{i5}, \gamma_{i1} \ldots \gamma_{i10}\right)' \tag{3}$$

$$y^i = \left(E_1^i \pi_{13}, E_2^i \pi_{14}, \ldots, E_T^i \pi_{T+12}\right)' \tag{4}$$

The system of (2) is a set of seemingly unrelated regressions (Zellner, 1962) allowing for panel level heteroskedasticity and contemporaneous correlations in forecasts across sub-groups. However, in addition to possible heteroskedasticity, the equations of (1) are very likely to exhibit residual serial correlation, due to the overlapping forecast horizons implied by employing monthly observations on annual inflation forecasts. Therefore, we employ ordinary least squares estimation in (2), but inference is based on the system-HAC (heteroskedasticity and autocorrelation consistent) procedure outlined in Anderson, Osborn and Becker (2009)[6]. System-HAC is a straightforward generalisation of the single-equation method of Newey and West (1987) in order to accommodate unknown correlation structures within and between equations. An appropriate bandwidth for the temporal disturbance correlation structure in the system is selected as the maximum of the bandwidths calculated separately for each equation in the system by 'automatic' bandwidth selection method for the quadratic spectral kernel proposed by Andrews (1991). The same kernel (weighting function) is then applied to capture both within and across equation residual autocovariances.

4. Influences on Inflation Expectations

Empirical results are discussed according to the demographic divisions employed, with a separate subsection for each. In all cases, results are shown for the estimated coefficients and the associated HAC-robust standard errors for each sub-group $i = 1, ..., n$ of the system in (2), with the R^2 of each regression also shown. The final two columns of each table show the HAC-robust test statistics for coefficient equality for that variable across all sub-groups (that is, testing $H_0: \beta_{1k} = \beta_{2k} = \ldots = \beta_{nk}$ where k is the specific variable) and statistical significance of the coefficients on that variable (specifically $H_0: \beta_{1k} = \beta_{2k} = \ldots = \beta_{nk} = 0$). For reference and in addition to also providing results for the gender panel, Table 3 includes the results for (1) estimated using observations for all agents (with Newey-West HAC inference).

[6] Such a setup is found to be justified since in each case residual analysis reveal that there is significant heteroskedasticity through a simple Breusch-Pagan test, significant correlations through examination of the AC and PAC, and strong (over 0.75 in all cases) contemporaneous correlation coefficients.

4.1 Gender

Results for the gender panel in Table 3 confirm the different inflation expectations processes of males and females. Although previously documented by Bryan and Venkatu (2001) for the US, these authors were unable to explain this finding. Our results imply, however, that there are gender-specific responses to lagged inflation, inflation differentials (particularly on transport) and news (especially positive news on government and defence and negative employment news). While the intercepts also differ, this is significant only at 10%. Note also that the all agent results in Table 4 attribute no significant role to either the apparel inflation differential or to favorable government and defence news, both of which are jointly significant (the latter at 1 percent) in the gender panel. On the other hand, the miscellaneous unfavorable news category is significant in the former but not the latter. The R^2 values indicate that the model explains effectively the same proportions of the temporal variation in inflation expectations for both sub-groups. Although this is a little less than for the all agent regression, the extent of variation being explained also differs (see Table 1).

The gender-specific responses to the transport cost differential are particularly interesting. Despite the high volatility of transport costs, as seen in Figure 1, it does not significantly influence the expectations of males. On the other hand, this differential has a negative influence on the expectations of females. Although we do not have expenditure information from the CES relating to gender, it is plausible that females are (on average) more aware of the current level of general inflation than that related specifically to transport costs, and hence net out the latter when updating their inflation expectations. It is also notable that a higher housing inflation differential lowers inflation expectations for both sub-groups, with females reacting more strongly than males. Indeed, a negative coefficient on this differential is a feature of all our results, and is discussed in subsection 4.4 below.

It could be argued that apparel is an area where women are likely to have a larger proportionate expenditure, and yet results suggest (albeit at only 10 percent significance) that males react more to this inflation differential. The food & beverage differential, although having a heterogeneous reaction, is not a significant contributor to the expectations of either sub-group and nor is the medical inflation differential.

Table 3: All Agent and Gender Panel Results

		All Agents	Gender Panel			
			Male	Female	Coefficient Equality	Zero Coefficients
	Constant	3.3281 *** (0.4935)	2.8119 *** (0.3971)	3.6967 *** (0.5412)	3.573 *	67.386 ***
	Lagged Inflation	0.3816 *** (0.0457)	0.2874 *** (0.0445)	0.4607 *** (0.0504)	21.215 ***	88.032 ***
Inflation Differentials	Medical	0.0045 (0.0598)	0.0051 (0.0434)	0.0058 (0.0794)	0.000	0.015
	Transport	-0.1299 * (0.0750)	-0.0405 (0.0629)	-0.1873 ** (0.0880)	5.214 **	5.878 *
	Housing	-0.5372 ** (0.2176)	-0.3681 ** (0.1735)	-0.6648 *** (0.2490)	2.812 *	7.671 **
	Apparel	0.0429 (0.0432)	0.0752 * (0.0397)	0.0142 (0.0505)	3.057 *	6.150 **
	Food & Bev	-0.0418 (0.0828)	0.0314 (0.0685)	-0.1057 (0.0948)	4.308 **	4.473
Proportionate News Heard: Favorable Changes	Government & Defence	4.7528 (3.7812)	-1.4638 (1.8701)	10.6301 *** (3.9361)	9.226 ***	9.244 ***
	Employment	2.1626 (1.4380)	1.4618 (1.0257)	2.8494 * (1.5275)	1.080	4.040
	Money & Profits	-2.2541 (1.9676)	-1.2900 (1.1123)	-5.2116 ** (2.5769)	2.731 *	4.566
	Inflation	-2.5074 (4.1791)	-0.6709 (2.8604)	-0.2516 (4.4590)	0.012	0.062
	Miscellaneous	-1.5527 (2.0400)	0.2592 (1.2292)	-3.4730 (2.3747)	2.554	2.607
Proportionate News Heard: Unfavorable Changes	Government & Defence	1.4440 (2.6126)	0.2416 (1.9495)	0.8552 (3.0364)	0.063	0.086
	Employment	-2.2613 *** (0.6838)	-1.2559 * (0.6763)	-2.6213 *** (0.7881)	5.145 **	11.823 ***
	Money & Profits	-2.4221 ** (0.9781)	-1.3487 (0.9251)	-3.3860 *** (1.0441)	3.516 *	11.154 ***
	Inflation	10.0994 *** (2.5466)	8.5227 *** (1.9623)	9.6683 *** (2.3005)	0.704	21.444 ***
	Miscellaneous	-3.1601 ** (1.5920)	-1.5778 (1.1716)	-2.1772 (1.6935)	0.144	2.590
	Adj-R^2	0.6505	0.5982	0.5739		

Notes: * denotes significance at the 10% level, ** at the 5% level and *** at the 1% level. All Agent results use the Newey-West HAC procedure for a single equation, while inference for the panel uses the system-HAC methodology of Anderson, Osborn and Becker (2009). Coefficient Equality shows the computed χ^2 test statistic for the null hypothesis of equal coefficients over sub-groups, while Zero Coefficients is the χ^2 statistic for the joint null hypothesis that all coefficients on the variable are zero; these test one and two restrictions, respectively. All results use a quadratic-spectral kernel and a modified Andrews (1991) bandwidth parameter of 6. Estimation is over January 1983 to October 2011 (345 observations).

The inflation expectations of females react more than those of men to hearing economic news not directly concerned with inflation itself. Some coefficients do not, however, have a clear economic interpretation. For example, both favorable and unfavorable news concerning money and profits lead to significantly lower inflation expectations for women. Also, more

defence spending could be either 'favorable' and 'unfavorable', depending on how this news is interpreted by the respondent (see Appendix Table A.2). Nevertheless, assuming that favorable news of this type is associated with increased defence spending and hence economic activity, the positive sign indicates women (but not men) interpret this as increasing future inflation. Females react symmetrically to employment news of both types, with directions compatible with the use of a Phillips curve type of relationship.

Despite the different responses to other economic news, there is no difference between males and females in their responses to inflation news: favourable news has no impact, whereas unfavorable news plays a strong role. Recalling that the news variables are expressed as proportions, for each additional one percent of either gender who report hearing unfavorable inflation news, mean inflation expectations of both sub-groups increase by nearly 0.1 percent.

4.2 Age

Turning to the age groups (Table 4), a broadly similar picture emerges, with a positive and heterogeneous response to lagged inflation and, within the inflation differentials, housing again has a negative effect, which is heterogeneous across groups. Transport and apparel inflation differentials also again show evidence of heterogeneity. Finally, economic news, and especially unfavorable news, influences inflation expectations.

Although the youngest age sub-group has proportionally the highest exposure to transport inflation (Appendix Table A.2), their significant negative coefficient suggests that they nevertheless negatively weight this differential when forming expectations, which is contrary to the hypothesis inflation expectations are based on that currently observed in their consumption basket. Amble and Stewart (1994) and Bureau of Labor Statistics (2004), suggest that the heterogeneity in inflation experience between older and younger consumers is driven primarily by medical inflation differentials. Nevertheless, while the medical inflation differential is (at 10 percent) significantly negative for older consumers, the overall hypotheses of identical responses over groups and of zero response to the differential are not rejected. Although consumers might therefore experience different rates of inflation, they generally appear to compensate for this in their expectations, perhaps suggesting that they do indeed forecast "prices in general".

Table 4: Age Panel Results

		Age Range			Coefficient Equality	Zero Coefficients
		18-34	35-54	55+		
	Constant	3.2363 *** (0.3693)	3.0966 *** (0.4589)	3.9146 *** (0.4798)	7.952 **	93.45 ***
	Lagged Inflation	0.4217 *** (0.0555)	0.4207 *** (0.0548)	0.2400 *** (0.0517)	20.307 ***	81.938 ***
Inflation Differentials	Medical	0.0582 (0.0749)	-0.0346 (0.0632)	-0.0956 * (0.0573)	1.951	2.058
	Transport	-0.1932 ** (0.0971)	-0.1248 (0.0832)	-0.0548 (0.0680)	11.338 ***	11.942 ***
	Housing	-0.8163 *** (0.2837)	-0.5062 ** (0.2443)	-0.3521 ** (0.1788)	6.472 **	10.789 **
	Apparel	0.0312 (0.0660)	0.0359 (0.0480)	0.0371 (0.0530)	5.034 *	6.485 *
	Food & Bev	-0.1559 (0.1124)	-0.0659 (0.0891)	0.0648 (0.0793)	10.550 ***	10.686 **
Proportionate News Heard – Favorable Changes	Government & Defense	0.7237 (2.5663)	3.2779 (3.1678)	-6.1614 * (3.2104)	1.795	4.045
	Employment	1.4528 (1.2652)	1.6570 (1.3727)	-0.2766 (1.0118)	4.091	9.129 **
	Money & Profits	-1.8142 (1.3577)	-1.4870 (1.3414)	-4.3032 ** (1.9213)	2.889	5.729
	Inflation	4.3315 (4.7110)	1.6634 (3.0491)	-6.4256 (4.0701)	2.204	2.762
	Miscellaneous	-2.3600 (1.5840)	-1.7311 (1.3737)	0.7340 (1.6526)	1.104	1.349
Proportionate News Heard – Unfavorable Changes	Government & Defense	-0.4004 (2.2251)	-0.1161 (2.1505)	3.3615 (2.1999)	0.900	0.913
	Employment	-2.8194 *** (0.8370)	-1.5772 ** (0.6500)	-1.1503 ** (0.5812)	0.614	7.821 **
	Money & Profits	-1.2860 (0.9446)	-2.2264 *** (0.8427)	-3.7223 *** (1.2849)	2.871	4.553
	Inflation	7.7230 *** (2.9897)	7.2315 *** (2.2365)	7.7730 *** (1.1860)	7.052 **	33.213 ***
	Miscellaneous	-1.6436 (1.3201)	-0.9795 (1.2961)	-3.3379 ** (1.5238)	4.412	11.504 ***
Adj-R^2		0.5023	0.5469	0.4197		

Notes: As for Table 4, except that results relate to the age panel, with tests for Coefficient Equality and Zero Coefficients test two and three coefficients, respectively.

Overall, there is little indication in Table 4 that different age sub-groups are strongly influenced in different ways by the economic news they hear. Although some individual coefficients are significant, the only positive news category that is significance overall relates to employment news, but no significant heterogeneity over age. As for the gender panel, negative news again strongly influences inflation expectations in Table 4. However, the null hypothesis of homogenous coefficients over age sub-groups is rejected only for inflation, despite the numerical differences here being small. Unfavorable employment news also has a

negative effect, which is homogeneous across groups, and there is individual but not joint significance for money & profits news.

4.3 Income

The income panel results are shown in Table 5, indicating heterogeneity in the influence of lagged inflation and in the food & beverage and (marginally) the transport inflation differentials. While most types of unfavourable news again play a role, there in more evidence of responses (with some being heterogenous) to favorable news than in the gender and age panels of Tables 3 and 4.

Poor households spend a higher proportion of their income on food than wealthier households, but there is no evidence that the inflation expectations of those from lower income households are influenced by differential inflation in this commodity category. Indeed, rejection of the null hypothesis of equal coefficients for this differential across income sub-groups, together with the signs and relative magnitudes of the estimated coefficients, indicates that respondents from lower income households may unduly compensate this differential when forming their inflation expectations. In common with females (Table 3), this sub-group negatively weights the transport cost differential, and the same explanation of conflating a high differential with unfavorable inflation news may apply. It is also the case that this sub-group place the greatest negative weight on the housing inflation differential (see subsection 4.4).

Once again, there is asymmetry in responses to favourable and unfavorable news, with the latter generally being a stronger influence on expectations than the former and especially for inflation news. Interestingly, in common with women (Table 3), the lowest income group interpret favorable news on money and profits as pointing to lower future inflation, whereas the highest income group interpret unfavorable news in this category as a signal for lower inflation. Both ends of the income sprectrum respond to employment news in a way compatible with a Phillips curve, although the lower income earners respond to favorable news, while negative news influences expectations of those at the higher end. On the other hand, both extremes react similarly to unfavorable news of the miscellaneous type (which can relate to declining consumer confidence or declining business trends), with this apparently

causing lower inflation expectations. Once again, negative inflation news plays a strong role, which is homogenous across groups.

Table 5: Income Panel Results

		Income Range			Coefficient Equality	Zero Coefficients
		Bottom 33%	Middle 33%	Top 33%		
	Constant	3.8077 *** (0.4746)	3.0451 *** (0.4042)	3.1940 *** (0.3972)	3.425	94.009 ***
	Lagged Inflation	0.4688 *** (0.0598)	0.3970 *** (0.0538)	0.3233 *** (0.0404)	13.696 ***	81.585 ***
Inflation Differentials	Medical	-0.0507 (0.0934)	0.0245 (0.0558)	-0.0165 (0.0458)	1.309	1.329
	Transport	-0.2101 ** (0.1041)	-0.0470 (0.0769)	-0.0809 (0.0604)	4.974 *	6.427 *
	Housing	-0.7163 *** (0.2747)	-0.3768 * (0.2267)	-0.4327 ** (0.1779)	2.740	8.874 **
	Apparel	0.0030 (0.0640)	0.0777 (0.0510)	0.0593 (0.0379)	2.231	4.345
	Food & Bev	-0.1742 (0.1088)	0.0616 (0.0810)	-0.0031 (0.0668)	9.154 ***	9.199 **
Proportionate News Heard – Favorable Changes	Government & Defence	4.9055 (4.0940)	1.6085 (3.0990)	4.1882 ** (1.7651)	0.805	8.839 **
	Employment	3.3923 * (1.8574)	1.6223 (1.0384)	-0.2045 (0.9130)	7.574 **	7.826 **
	Money & Profits	-9.2682 *** (2.5149)	-1.1331 (1.6478)	-1.7658 * (1.0701)	11.155 ***	16.161 ***
	Inflation	-0.9075 (5.9266)	-3.7578 (3.4146)	0.5816 (2.6249)	1.562	1.682
	Miscellaneous	-1.9490 (2.5029)	0.0973 (1.6373)	0.0395 (1.0620)	0.690	0.695
Proportionate News Heard – Unfavorable Changes	Government & Defence	0.2977 (2.5356)	-0.4600 (2.0465)	0.7050 (1.3969)	0.608	0.849
	Employment	-0.4423 (1.0643)	-1.2240 (0.7518)	-2.7289 *** (0.6188)	13.543 ***	30.149 ***
	Money & Profits	-2.8470 (1.8409)	-2.2416 ** (0.9643)	-2.1441 *** (0.7669)	0.208	9.324 **
	Inflation	6.3763 *** (2.0893)	8.1594 *** (2.2871)	7.4270 *** (1.6255)	0.705	22.856 ***
	Miscellaneous	-3.5673 * (2.1402)	-0.3022 (1.0777)	-2.6860 *** (0.9456)	4.678 *	10.067 **
Adj-R^2		0.3671	0.4740	0.6284		

Notes: As for Table 4, except that results relate to the income panel, with tests for Coefficient Equality and Zero Coefficients test two and three coefficients, respectively.

It was noted in relation to Table 1 that the upper income sub-group report hearing more economic news than other sub-groups, which is compatible with their being more economically sophisticated. This is supported also by other evidence. In particular, the R^2 is

larger for this than for other sub-groups in Table 5, while at the same time they put less weight on lagged inflation when forming their expectations. It appears, therefore, that the inflation expectations of this income sub-group responds more strongly than others to the information contained in recent economic news.

4.4 Overview

In summary, lagged inflation always has a positive but heterogenous effect across all panels examined. The housing inflation differential always has a negative effect on expectations, which is heterogenous across both gender and age sub-groups. We find no clear evidence that inflation expectations are positively influenced by inflation rates in the commodity categories accounting for the highest proportions of expenditure.

The strongest and most consistent news effects overall relate to negative news. When inflation news is heard, the effect on expectations is (relatively) homogenous across demographic sub-groups. A role is often also found for employment news, and in a direction compatible with a Phillips curve, but (depending on the sub-group) this is sometimes manifested as a response to positive, rather than negative, news. While coefficients on news concerned with money and profits are also sometimes significant and heterogenous over sub-groups, the signs are typically negative irrespective of the favorable or unfavorable nature of this news.

Finally, the negative, and signficiantly different responses of sub-groups across all panels to the housing inflation differential is noteworthy and *a priori* surprising. However, as noted in subsection 2.1 above, the CPI computations for housing costs are partially imputed, in the sense that a market rental equivalent is applied for owner-occupied accommodation. Even if consumers include housing costs when responding to a question regarding "prices in general", owner-occupiers are not exposed to rental cost inflation. The significant negative coefficients on this variable may therefore reflect at least a substantial proportion of consumers being unaware of changes in housing costs as measured in the CPI-U, so that current general price movements as perceived by the consumer do not include this component.

5. Conclusions

Research using inflation expectations data from the University of Michigan SRC commonly compares expected inflation to national 'all agent' inflation, as measured by CPI-U. Such a comparison is valid only if agents are truly forecasting 'prices in general', as requested by the survey. However, previous research establishes that ...Against this background, the present study empirically investigates the influences on aggregate inflation expectations across various demographic sub-groups, focussing particularly on the role of inflation differentials for major commodity groups (in relation to overall CPI-U) and the impact of various types of economic news. Our results can be summarised as indicating that some potential explanatory variables play no role at all, some have effectively common effects across demographic groups compared with and forecasting processes using commodity group inflation, to ascertain whether this question is indeed interpreted by respondents as asking about national inflation, or instead is interpreted in relation to inflation experiences. Our findings are in line with the latter interpretation rather than the former, indicating heterogeneity in the formation of inflation expectations.

To be more specific, our analysis shows clear differences in how certain sub-groups of consumers, where one demographic feature is held constant, use inflation in commodity categories when forming inflation expectations. In particular, age and to a lesser extent, gender demographic groupings, show the most significant heterogeneity across sub-groups. Although an examination of Consumer Expenditure Survey data reveals differences in the allocation of expenditure to commodity categories across demographic sub-groups, our results do not suggest that relatively higher expenditure in a category necessarily aligns with inflation for that type of commodity playing a greater role in the formation of inflation expectations. Rather, the differences in the age group can be seen mainly in relation to frequently purchased commodities, including food, and (to a less marked extent) apparel and transportation. The gender analysis suggests a similar though weaker link between expectations and frequently purchased commodities.

We have also examined the influence of types of news on forecasts, and find generally find the most heterogeneity of response in relation to negative employment news. There is strong and generally equivalent positive response to negative inflation news. The direction of responses to news is in the main entirely rational, suggesting consumers are attentive to

media reported economic conditions, which in the main, are more persuasive for forecasts when these are of a negative nature. What is more, the sophistication of response to some types of news suggests agents have a good knowledge of how factors such as employment will affect the economy.

Our results using demographic sub-group data from the Michigan SRC find significant differences in the factors influencing forecasts throws into doubt the validity of testing the rationality of these forecasts against CPI-U inflation. More importantly, the complexity of the expectations processes makes it more difficult for the Fed to understand and influence consumer inflation expectations in order, ultimately, to control the rate of inflation itself.

Appendix 1: Consumer Expenditure Patterns

The Consumer Expenditure Survey (CES), from which aggregation weights are calculated for items in CPI-U, involves the annual sampling of around 45,000 individuals, with expenditure then recorded for the consumer unit or household (Bureau of Labor Statistics, 2011). Since the release of the 2002 CPI-U, weights are updated on a biennial basis, using CES data from two years previously[7].

Table A.1, based on CES data for 2005, is indicative of the average expenditure on various commodity categories[8]. It shows how total average expenditure is distributed over these categories, together with corresponding information for various demographic and regional sub-groups of the population.

[7] Prior to this, weights could be based on a CES survey data from up to five years previously.
[8] CPI and CES commodity groups do not match exactly, since the former measures consumption prices, and so excludes investment items, cash gifts, fines etc.

Table A.1: CES Implied Purchasing Habits

2005		Apparel and services	Cash contributions	Entertainment	Food	Health care	Housing	Personal care products & services	Personal insurance & pensions	Transportation	Other	Average annual expenditures
All Consumer Units	$	1,886	1,663	2,388	5,931	2,664	15,167	541	5,204	8,344	2,621	46,409
	%	4.06	3.58	5.15	12.78	5.74	32.68	1.17	11.21	17.98	5.65	
Lowest 20% Income	$	857	545	891	3,047	1,448	7,529	253	481	2,742	1,327	19,120
Quintile	%	4.48	2.85	4.66	15.94	7.57	39.38	1.32	2.52	14.34	6.94	
Reference Person	$	1,577	393	1,393	3,933	704	8,940	337	2,133	5,987	2,379	27,776
Under Age 25	%	5.68	1.41	5.02	14.16	2.53	32.19	1.21	7.68	21.55	8.56	
Reference Person Over	$	957	1,889	1,593	4,163	4,193	11,058	462	1,775	5,171	1,605	32,866
Age 65	%	2.91	5.75	4.85	12.67	12.76	33.65	1.41	5.40	15.73	4.88	
Region of Residence:	$	1,975	1,627	2,950	6,339	2,647	18,016	623	5,789	10,068	2,857	52,891
West	%	3.73	3.08	5.58	11.99	5.00	34.06	1.18	10.95	19.04	5.40	
Region of Residence:	$	1,750	1,868	2,384	5,754	2,841	14,151	514	5,212	7,753	2,800	45,027
Midwest (NC)	%	3.89	4.15	5.29	12.78	6.31	31.43	1.14	11.58	17.22	6.22	
Region of Residence:	$	2,036	1,370	2,263	6,495	2,581	16,421	540	5,353	7,732	3,130	47,921
Northeast	%	4.25	2.86	4.72	13.55	5.39	34.27	1.13	11.17	16.13	6.53	
Region of Residence:	$	1,836	1,710	2,112	5,491	2,606	13,402	508	4,760	7,990	2,089	42,504
South	%	4.32	4.02	4.97	12.92	6.13	31.53	1.20	11.20	18.80	4.91	
Education: College	$	2,670	2,787	3,402	7,610	3,480	21,676	805	8,523	10,664	3,925	65,542
Graduate or above	%	4.07	4.25	5.19	11.61	5.31	33.07	1.23	13.00	16.27	5.99	

Notes: For each demographic or regional sub-group, the first row presents average expenditure on each commodity category and the second row shows this as a percentage of the total for the sub-group. The source for this data is the Bureau of Labor Statistics Consumer Expenditure Data (CX) flat file obtained from ftp://ftp.bls.gov/pub/time.series/cx/ (also summarised in Consumer Expenditure Survey 2005 tables 1, 3, 8, 10).

Appendix 2: Types of News

Table A.2: Detailed Breakdown for Favorable News

Government & Defence	Recent or upcoming elections; new administration/Congress/President
	More defence/military spending or production; worsening international situation/prospects; acceleration of war/tensions; more uncertainty about world peace
	Less defence/military spending or production; better international prospects; fewer international tensions; less uncertainty about world peace
	Specific government spending programs reformed/changed/improved--NA whether increase or decrease in spending
	Specific government spending programs, begun or increased/continued (other than defence) (e.g., employment, foreign aid, space, welfare) (incl. Programs modified/"improved" if increased spending is stated or implied)
	Specific government spending programs eliminated or decreased (other than defence) (e.g., employment, foreign aid, space, welfare) government facilities/bases closed
	Taxes: tax changes/reforms; tax rebates
	Other references to government
	Fiscal policy general; budgets; deficits; government spending in general
	Government/Congress/Administration/President is taking steps to improve business condition s/is taking right/helpful actions
Employment & Purchasing Power	Opening of plants and factories; opening of stores (e.g., Meijer's)
	Consumer or auto demand is (will be) high; people want to buy; are buying
	Purchasing power is (will be) high; people have money to spend; wages high/will go up; any kind of personal income high or higher
	Employment has risen/is rising; more overtime; plenty of jobs or work around; unemployment declining
	Population increase; more people to buy/use goods and services
	Low (lower) debts; high (higher) assets/savings; people/business investing; investments up
	Other references to employment and purchasing power
	Production is increasing/is high; GNP is up
	Unemployment has risen/will rise (and that's good or necessary for the economy
Inflation	Lower or stable prices; prices won't rise; lower prices; less inflation; price rebates
	High(er) prices; inflation; prices will rise (incl. specific prices) (and that's good)
Money & Profits	Tight money; interest rates high; credit harder to get
	Easier money; credit easy to get; lower interest rates
	Profits high/rising
	Stock market; rise in price of stocks
	Other references to prices/credit
	Balance of payments; world monetary situation; foreign competition; dollar devaluation
	Controls (price and/or wage)
Miscellaneous	Better race relations; less racial unrest; few urban social problems; less crime
	Union disputes/strikes have been (will be) settled; labour-management relations good
	Times are (business is) good now and won't change (much) in the next year
	Bad times can't last; we are due for good times
	Respondent sees signs of improvement already; (heard or read that) business is improving/good
	Improvements in specific industries; prospects good (favourable changes) in Respondent's line of work (except farming) or in locality
	Farm situation good; crops good
	Other good factors or favourable references (include Respondent has heard or read that business will improve--no specific reason) (hasn't happened yet)
	Economy in general more stable/under control; confidence, optimism on part of consumers in general (not individual)
	Energy crisis, depletion of natural resources; control of pollution; shortages; energy crisis lessened

Table A.3: Detailed Breakdown for Unfavorable News

Government & Defence	Recent or upcoming elections; new administration/President
	More defence/military spending or production; worsening international situation/prospects; acceleration of war/tensions; more uncertainty about world peace
	Less defence/military spending or production; better international prospects; fewer tensions; disarmament; less uncertainty about world peace; military bases closed
	Specific government spending programs reformed/changed--NA whether increase or decrease in spending
	Specific government spending programs eliminated or decreased (other than defence) (e.g., employment, foreign aid, space, welfare); government facilities closed (include programs "modified" if decreased spending is stated or implied)
	Specific government spending programs begun or increased/continued (other than defence)(e.g., employment, foreign aid, space, welfare)
	Taxes: tax changes/reforms; tax rebates
	Other references to government
	Fiscal policy general; budgets; deficits; government spending in general
	Government/Congress/Administration/President is not taking steps to improve business conditions/is taking wrong/harmful actions
Employment & Purchasing Power	Closing of plants and factories (general or specific), closing of stores (e.g., Grant's)
	Consumer or auto demand is (will be) low; people don't want/need to buy, aren't buying; people are saving their money; inventories high; sales down
	Lack of purchasing power; people don't have money to spend; low wages; any kind of personal income low or lower
	Drop in employment; high or higher unemployment; layoffs; less overtime; short hours; automation
	Population increase; immigration
	High (higher) debts; lower assets/savings; people/business not investing; investments down
	Other references to employment and purchasing power
	Production decreasing; production is low; GNP is down
Inflation	Prices are falling/will fall/are too low; deflation
	Prices are high, are rising, inflation; wages lag behind prices
Money & Profits	Tight money; credit hard to get; interest rates too high, rising
	Profits low, falling
	Profits high; too high
	Stock market references; decline in price of stocks
	Other price/credit references
	Balance of payments; foreign competition; world monetary situation; dollar devaluation; international trade
	Controls (price and/or wage)
Miscellaneous	Bad race relations; racial unrest; riots, civil disorders; urban social problems; (more) crime
	Excessive wage or other demands by unions; strikes; labour unrest; labour-management relations bad
	Times are (business is) bad now and won't change (much) in next year
	Good times can't last--we are due for a fall
	Respondent sees signs of downward trend in business already; (Respondent has heard or read that) business is bad/worsening
	Decline in specific industries; problem in Respondent's line of work or locality
	Farm situation is bad; drought; low farm prices
	Other unfavourable or bad factors (include Respondent has heard or read that business will decline--no specific reason) (hasn't happened yet)
	Economy in general less stable/not under control; lack of confidence on the part of consumers in general
	Energy crisis; depletion of natural resources; pollution; shortages

Note: Individual categories are defined by SRC, for example, pg.8-11 of the November 2002 codebook: http://www.icpsr.umich.edu/cgi-bin/file?comp=none&study=34535&ds=1&file_id=1109388&path=ICPSR

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